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ABSTRACT

Continued advances in computerized training technology allow for a better link between instruction and evaluation. The use of computer-controlled audio and video feedback takes the automation of a mastery learning approach with its frequent shifts between instruction and testing a step further and begins to blur the distinction between training and evaluation. The students are empowered to be their best critics and they take over part of the role of their supervisor or evaluator. Students are first trained on how to analyze correct use of a skill, then they are given the means to analyze their own performance based on the criteria provided. Students are reminded of these criteria as they view their performance. Based on their own evaluation, they can repeat their efforts until their skill level meets the criteria they were trained on. Their supervisor is relieved of this initial evaluation effort and students are given an opportunity to internalize these self-evaluation skills for ongoing use. To make full use of the potential within such advances in automated instruction requires the development of instructional models that empower students to be their own best evaluators and which integrate evaluation and training. Descriptions of two versions of the system are provided--one using interactive video coupled with a videotape recorder and camera, the other using CD-ROM technology to capture and record student responses in a completely digitized, audio-only feedback environment--as well as case study examples of its use in industrial and corporate training, and evaluation study results of its teaching effectiveness. (25 references) (GL)

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Using Computer-Controlled Audio/Video Feedback to Integrate Evaluation and Training

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Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, 1989. The ideas and training technology in this paper reflect the efforts of many people at Spectrum Interactive. The initial project which supported the development of the system described in this paper was funded by the Massachusetts Mutual Life Insurance Co. through the support of Jane Curtis, Director of Field Development.

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For the last several hundred years, books have been the main form of self-paced instruction, but more recent advances in instructional technology such as television and computers have brought new ways to reach a learner without the use of an instructor. Within the past several years laserdisc technology has allowed for the integration of television and computers to offer further advances through interactive videodisc training (IVI). Laserdiscs, when coupled with a computer and a touch screen monitor, result in a training system that offers full motion video presentations as well as computer text and graphics, the ability to branch from one part of the material to another, student quizzes and tests, and directed remediation when material has not been mastered.

Each new advance in instructional technology expands the areas of content which are appropriate for self-paced instruction (Ives, 1987). Print, for example, is useful for presenting logical arguments since it requires us to assemble our wide ranging ideas into a linear and logical order. In fact, some psychologists have argued that a new instructional medium, text, prompted new ways of thinking and the advent of the logical essay, when text replaced the oral tradition in education at the end of the middle ages (e.g., Havelock, 1976; Olson, 1973). Now the introduction of computerized instruction is being promoted by some (e.g., Provenzo, 1986) as equal in instructional significance to that of print.

This new medium - interactive, computer-based video training - allows for many instructional advances over print. For example, tasks which involve a decision making process, such as

carrying out a sales strategy or diagnosing technical problems have been generally taught in a experiential mode either in a classroom or by a personal mentor and not through books. This has made sense as such activities are difficult to map onto a linear path as required by text or even linear video.

Psychological research has supported this decision as studies have shown that textual knowledge per se does not make it possible to solve problems. For example, information coded for verbal recall can be inappropriate for problem solving (Olson, 1973). Verbal instruction, by itself, is of limited usefulness; an activity-based curriculum is generally required for the achievement of practical competence (Olson, 1973). But now we can put some of this problem solving activity and interactivity on the computer screen and self-paced instruction is no longer confined to a linear mode as it was in print or linear video. Initial research indicates that computerized instruction which requires problem solving can promote higher order thinking (Patterson & Smith, 1985).

While the results of evaluation studies of IVI programs have not been totally in agreement (e.g., Bosco, 1986; Eiserman & Williams, 1988), the technology appears to be effective in both knowledge and skill building curricula. For example, DeBloois (1988) found in a review of thirty evaluation studies of interactive videodisc training programs that:

- IVI apears equally suited for skills training and concept learning
- students are enthusiastic about IVI, recognizing and enjoying the benefits of self-paced learning with the anonymity and control it provides
- comprehension gained through IVI is at least comproable and often greater than classroom training and it frequently occurs in less time and at a lower expense

However, while IVI has proven to be an effective tool in helping students recognize proper behavior within human interactions, by itself, it is unable to help student recognize if they are capable of actually performing the behavior being taught. The best an IVI program can do is to ask the student to observe a particular activity and then judge whether of not it was done properly. To

make the role play truly effective, it is necessary to inject the student into the course. In fact, DeBloois (1988) found in his review of IVI program evaluations that students often recommended mixing IVI with live role-playing for skills training.

A recent further advance in instructional technology, the use of computer-controlled audio/video feedback of student performance, has allowed for this missing component to be incorporated into the self-paced IVI format. Feedback on live performance can now be done with the same anonymity and individual control that students appreciate in IVI programs. Past research indicates that video feedback is effective for teachnig interpersonal skills (e.g., Berger, 1978; Esveldt, Dawson, & Forness, 1974). Now this method can be used in an automated, individualized system.

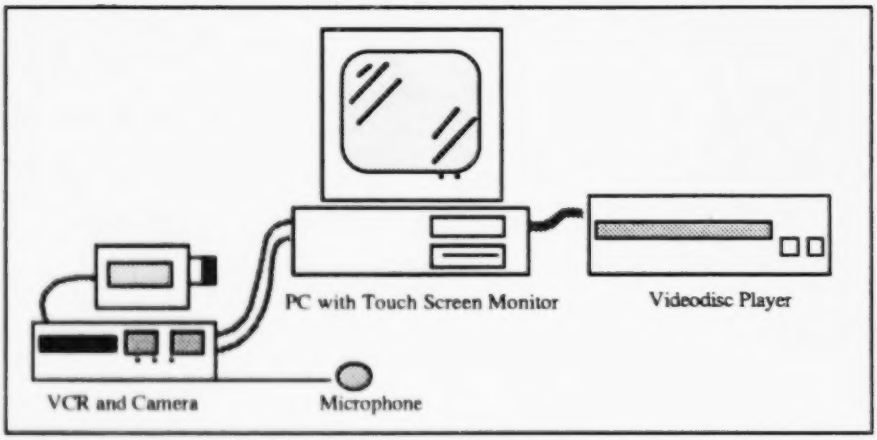
This paper will present the components of this new instructional technology, how it effects curriculum design and offer some case study examples of its use in industrial and corporate training along with evaluation study results of its teaching effectiveness. Two versions of the system will be described. One uses an IVI system coupled with a videotape recorder and camera. The second uses CD-ROM technology to capture and record student responses in a completely digitized, audio-only feedback environment. The IVI program is essential when face to face skills are being taught, the CD-ROM offers a more cost-effective, reliable, and potentially more flexible system for situations such as telephone skills where audio-only performance assessment is acceptable.

IVI System for Computer Controlled Audio/Video Feedback

The IVI system is comprised of an interactive videodisc system (a laserdisc player, a touchscreen monitor, and a personal computer) coupled with a videotape recorder, camera and microphone. The CD-ROM system is somewhat similar and it will be discussed later. The IVI system configuration is displayed on the next page.

Figure 1

Components of the IVI System



The interactive video components let the student understand the need for a particular skill, observe how it is done, and recognize proper or improper behavior. The recorder, camera and microphone are used to record the behavior of the student as he or she would perform in a given situation. Additional performances can be practiced over and over again, until the student is confident that the proper behavior has been mastered.

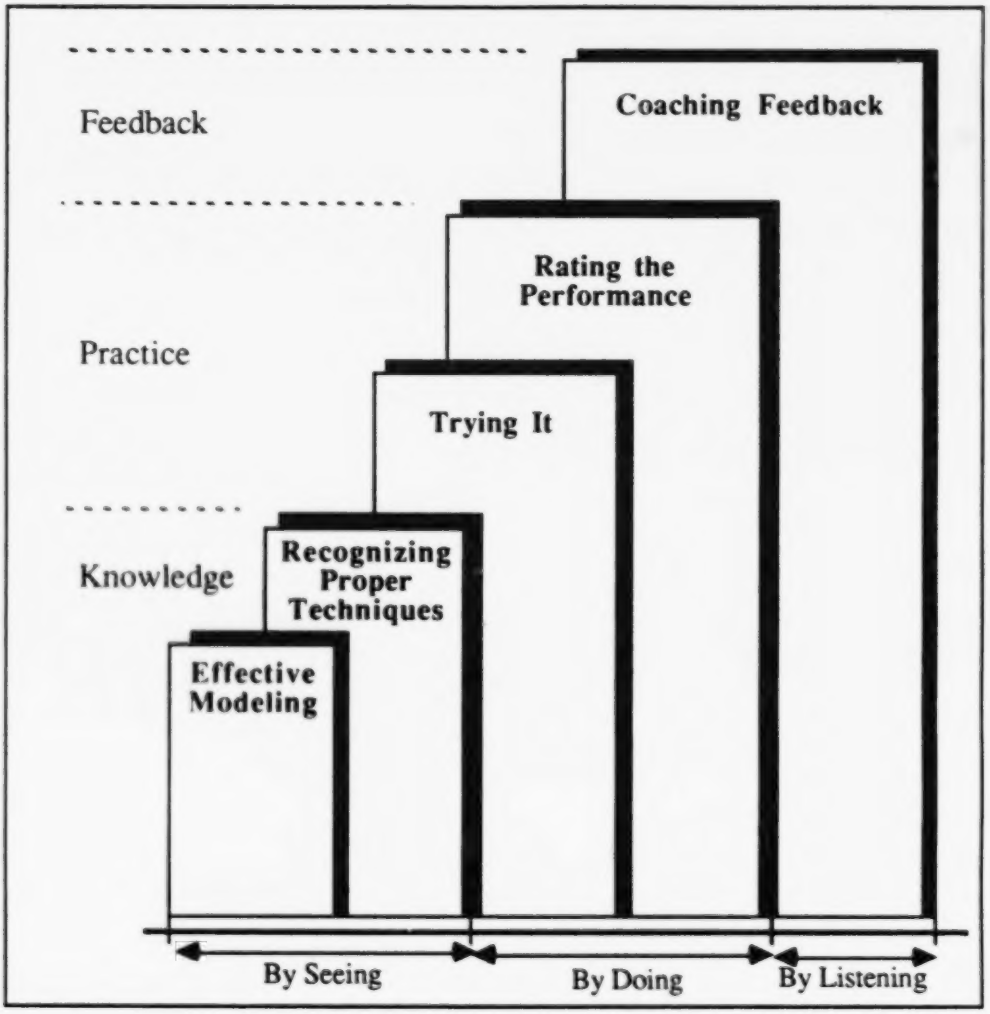
Instructional Model

The introduction of a new technology, by itself, does not necessarily lead to improved instruction. In fact, as several have argued (e.g., Gery, 1989; Hooper & Hannafin, 1988), there is a danger when a new technological appears that we focus on too much on the technology itself and not on good instructional strategies for its use. However, we cannot simply use the proven instructional approaches of past media since each new medium requires somewhat unique approaches to maximize its effectiveness (e.g., Olson, 1976; Salomon, 1979) and each medium affects cognition in different ways (e.g., Ives, 1980; Olson, 1976). A training and evaluation approach will be presented now which offers five levels of learning, the last three being made possible by the new

instructional technology. Some variations on this model will be discussed later. These five levels are seen in the diagram below.

Figure 2

Components of Instructional Model



Level 1: Effective Modeling

Use of a videodisc program allows the student to *observe* the critical components of the skill behavior in detail. Behavior is broken down into steps, with the consequences of specific techniques shown. The medium offers ample room to present variations in approaches, that are retrievable upon demand.

Level 2: Recognizing Proper Techniques

The next step is to teach and practice *recognition* skills so the student can learn to identify proper instances of the skill. The use of "action maze" exercises provide an opportunity for the student to interrupt the presentation of a skill when a mistake is made and offer a proper critique of the action. Feedback is given on the appropriateness of their analysis. A critical point for these first two levels is that the system is providing the basis for the student to internalize a mental image of the skill being taught - first by modelling the skill and then by validating that the student can recognize a correct model. These first two levels are possible in current IVI applications and found in many programs. The new instructional technology allows for three further steps which serve to more fully integrate training and evaluation.

Level 3: Trying It

The camera or audio recorder component of the system is now employed to make the students *demonstrate* the behavior they have seen. The students' performance in an interpersonal situation is recorded along with the stimulus conversation which preceded their response. Students can practice different approaches in **privacy**, thus encouraging experimentation, and yet they are able to see themselves from another's perspective.

Level 4: Rating the Performance

By reviewing their own recorded performance, after being provided with a set of criteria, students can *validate* their own behavior. This is possible because students certified their ability to judge performances by the successful completion of Level 2. They can erase and repeat Level 3, practicing as many times as they wish. They have **control** over when a permanent record of their performance is made and thus they have control over what is viewed by others.

Level 5: Coaching Feedback

Continuous practice of the behavior should result in a polished effort. Now they can take their best effort on tape to their supervisor or an expert in the field who can concentrate on *advanced coaching* rather than teaching basic skills. Students also can periodically return to the system for additional structured practice and self-evaluation. This new system has added the missing "try it" component to the define-recognize-identify-differentiate model of current videodisc courseware. Unlike instructor-led role plays, students can try again and again with a tireless tutor, perfecting the skills itself and the mechanisms needed for self-critical reflection, awareness, and readiness.

How has this worked in actual programs? In the initial case (Curtis, 1988; Drake, 1988), insurance agents were provided with sales training through the IVI version just described. In an initial pilot evaluation program, there was a 16% increase in calls, a 24% increase in kept appointments, and a 43% increase in approach interviews with clients following completion of the training. In addition, training time was reduced by 30% over traditional classroom methods. Sales representatives who went through the program also acheived a significant increase in sales, with more experienced salespeople benefiting the most from the program.

Several new programs are now under development using this instructional model. In one case, providing sales skills for a high technology company, students are offered the choice of guided or

unguided practice taping sessions. The **unguided version** works like the model just described; the criteria for how to best respond to the customer stimulus is provided after the first taping session, just before the student views their performance. However, at any point they are allowed to branch back to see the original positive role model before they are taped trying it themselves. In the **guided version**, students are asked to choose from several possible strategies to take with their client after viewing the client's question. They then receive feedback on their choice and an indication of the best strategy to take in response to the client's question. Only at this point are they actually taped responding to the client. This way the program allows them to see how they perform using the best strategy and guides them away from ever practicing a wrong approach.

CD-ROM System for Computer Controlled Audio Feedback

CD-ROM is providing the means for a revolution in multi-media training and communication (e.g., Gery, 1988; Ives, 1989; Miller & Laskaris, 1988) and it is becoming increasingly viable in a variety of training situations. In this case, the small size of the compact disc and the relatively low cost of CD-ROM players (currently around $600 in quantity), makes it a possible technology of choice over IVI for certain applications.

CD-ROM can offer most of the multi-media format found in IVI except that it is currently limited to still video images and cannot practically offer motion video. However, with still images the system maintians the multi-media combination of text and image that has the potential for additive effects on learning (e.g., Paivio, 1979). In fact, some research has suggested that for certain interpersonal skill training applications, still images facilitate an equivalent level of comprehension to that provided by full motion video. For example, one study (Barnes, 1988) we conducted found still frame videodisc training to be equally effective to full motion training for management skills development and 97% of the students tested felt it was a viable training medium.

In certain training situations, research has indicated that still images with audio actually may be more appropriate than motion video. For example, viewers who saw a still image and audio presentation of a story offered more imaginative responses to questions requiring inferences from the material than viewers who saw a motion video version of the same story (Meringoff, 1980). In another study, exposure to motion video presentations which explicitly portray events lead to fewer responses which generalize beyond the facts given than a similar exposure to audio and still image presentations (Meline, 1976). Research by others has suggested that the potential to supply more precise realism does not mean that realistic images should always be used in automated instruction (Hooper & Hannafin, 1988).

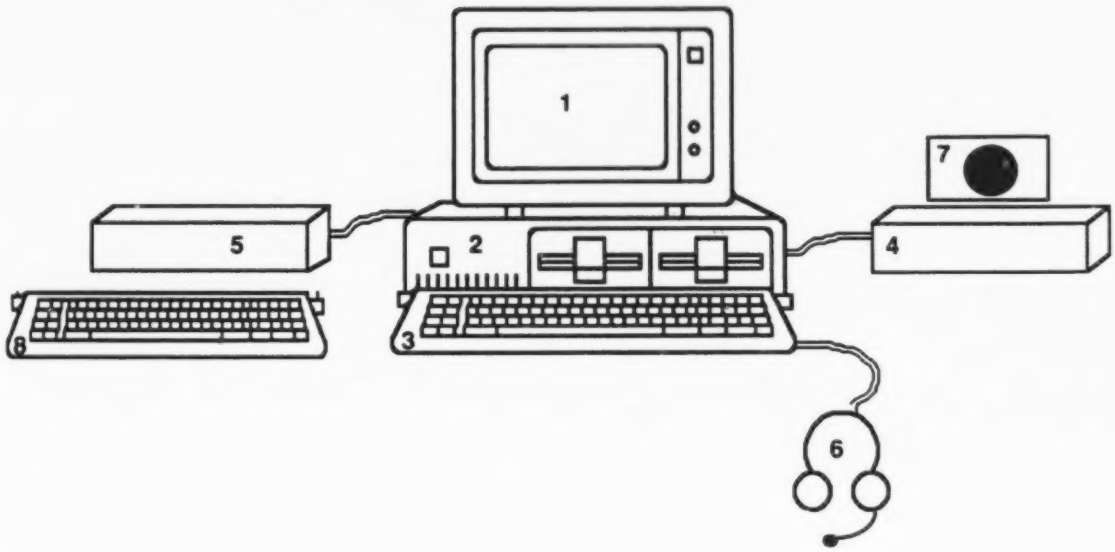
In addition, for some training situations, the use of audio feedback is actually closer to the real job situation than the combination of audio and motion video. For example, CD-ROM audio supported training is probably a better technology for the telephone skills training than interactive videodisc technology. In this case, a CD-ROM system would provide the following benefits over an IVI system:

- **Reduced Cost:** CD-ROM costs approximately $2,000 less per training station than interactive videodisc
- **Enhanced Realism**: CD-ROM audio feedback more closely duplicates the telephone users work environment.
- **Increased Power**: A single CD-ROM can better store additional information necessary to realistically represent the work environment of the telephone user. A single CD-ROM can store over 550 megabytes of information or the equivalent of 1,400 floppy discs
- **Greater Portability**: The CD-ROM systems are generally smaller and lighter than IVI systems.
- **Industry Standard Hardware**: Many CD-ROM system can be more easily used for other training or non-training purposes than IVI systems.

The components of a CD-ROM system are illustrated on the following page:

Figure 3

Components of the CD-ROM System



The CD-ROM System for Computer-Controlled Audio Feedback includes:

1 Color Monitor

2 Personal Computer with Hard Disc

3 Keyboard

4 CD-ROM Drive & CD-ROM Controller

5 Audio Cassette Recorder

6 Operator Headset.

7 Audio Speaker

8 Optional Special Keyboard (when learner job environment uses special keyboards)

We are currently creating a curriculum for a credit card company using the CD-ROM audio system. An example of how this system might work can be found in the following training sequence:

- Computer randomly selects a customer call from a CD-ROM training call library
- Student responds to customer call
- Student listens to customer and sees a still image of the customer on the computer screen or sees their computer terminal screen
- Customer asks a difficult question which requires a consistent response, such as explaining average daily balance or the travel insurance policy
- Student responds and has their response recorded
- Student executes keying strategy to search the database for customer record
- Student finds correct record and generates a report if necessary
- On-line stopwatch records total time required

The CD-ROM training system records both the system generated audio and the student's audio portions of this entire interaction. As with the IVI systems, the tape of these interactions may then be reviewed by students for self-monitoring and the sequence may be re-recorded. Once the student is satisfied with the quality of the performance, the final tape may be taken to a supervisor or content expert for evaluation purposes thus providing an advanced assessment of student performance.

Summary

The continued advances in computerized training technology allow for a better link between instruction and evaluation. However, this possibility could be hampered by a traditional view of training as treatment and testing as the dependent variable (Baker & O'Neil, 1987). The use of computer-controlled audio and video feedback takes the automation of a mastery learning approach (e.g., Bloom, 1969), with frequent shifts between instruction and testing, a step further and really begins to blur the distinction between training and evaluation. The students are empowered to be their best critics and they take over part of the role of their supervisor or evaluator. Students are

first trained on how to analyze correct use of a skill, then they are given the means to analyze their own performance based on the criteria provided. Students are reminded of this criteria as they view their performance. Based on their own evaluation, they can repeat their efforts until their skills level meet the criteria they were trained on. Their supervisor is relieved of this initial evaluation effort and students are given an opportunity to internalize these self-evaluation skills for ongoing use.

To make full use of the potential within such advances in automated instruction as the feedback system described in this paper, we need to create instructional models which empower students to be their own best evaluators and which integrate evaluation and training.

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